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TOWNSEND and TOWNSEND and CREW LLP

By: /Maria A. Mammina/

PATENT
Attorney Docket No. 018563-002920US
Client Ref. No. 9032.ALG.XC1

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of:	
PAVLOVSKAIA, ELENA *et al.*	Conf.No. 4730
Application No.: 10/633,015	Examiner: Yogesh P. Patel
Filed: July 31, 2003	Art Unit: 3732
For: SYSTEMS AND METHODS FOR REMOVING GINGIVA FROM COMPUTER TOOTH MODELS	**APPELLANTS' BRIEF UNDER 37 CFR §41.37**

Mail Stop Appeal Brief
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Commissioner:

Further to the Notice of Appeal mailed on March 17, 2010 for the above-referenced application, Appellants submit this Brief on Appeal. Appendix A, attached hereto, is marked as the Claims Appendix and contains a copy of all claims pending in this case. Appendix B, attached hereto, is marked as the Evidence Appendix. Appendix C, attached hereto, is marked as the Related Proceedings Appendix.

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1. REAL PARTY IN INTEREST

All right, title, and interest in the subject invention and application is assigned to Align Technology, Inc., having offices at 881 Martin Avenue, Santa Clara, California 95050. Therefore, Align Technology, Inc. is the real party in interest.

2. RELATED APPEALS AND INTERFERENCES

No other appeals or interferences are known which will directly affect, or be directly affected by, or have a bearing on the Board's decision in the pending appeal.

3. STATUS OF CLAIMS

Claims 1-31 and 37-39 are currently pending. Claims 32-36 have been previously canceled. Currently pending claims 1-31 and 37-39 stand rejected under 35 U.S.C. § 103(a). Currently pending claims 1-31 and 37-39 are the subject of this appeal. No other claims are pending.

It is noted that the summary page in the Non-Final Office Action mailed December 17, 2009 incorrectly lists the claims pending, but the correct pending claims are listed in the body of the Office Action and are also correctly identified in the status listed above.

4. STATUS OF AMENDMENTS

No amendment to the claims was filed subsequent to the Non-Final Office Action mailed December 17, 2009. A copy of all the pending claims involved in the appeal is provided in the Claims Appendix, attached hereto.

Appellants acknowledge the telephone conference discussion between Appellants' undersigned representative, Examiner Patel, and SPE Rodriguez occurring on January 6th, 2010. Appellants expressed confusion as to the basis of the withdrawal, per the 12/17/2009 Office Action, of the allowability of claims 22-25 and 38-39 indicated in the Office Action mailed 4/13/2009. Appellants further pointed out the failure of the cited references to teach or suggest the currently claimed invention. No agreement was reached, and SPE Rodriguez invited Applicants to initiate this Appeal.

5. SUMMARY OF CLAIMED SUBJECT MATTER

The present invention relates generally to the field of orthodontics and, more particularly, to computer-automated separation of a model of teeth. U.S. Application No. 10/633,015, filed July 31, 2003 (hereafter "Application"), page 1, lines 11-12. In one aspect, the invention includes computer-implemented techniques, methods, systems, computers, programs for separating a tooth from an adjacent structure, such as a gingiva, by defining a cutting surface, and applying the cutting surface between the tooth and the structure to separate the tooth (e.g., in a single cut). Application page 2, lines 15-17. Advantages of the invention can include, for example, a system that provides a flexible cutter that can be modified to follow the gingival line so a user could cut off the gingiva in one single cut. The gingival line defined by the user here could also be re-used later for the gingival reconstruction process. Application page 3, lines 28-31.

Independent claim 1 is directed to a computer-implemented method for separating gingiva (300) from a tooth (301) on a computer model of the gingiva (300) and the tooth (301). The method includes defining a three dimensional closed cutting surface (302) passing through a line (304) between the gingiva (300) and a crown of the tooth of the computer model (upper part of 301), the crown defining a volume, wherein the closed cutting surface (302) comprises a crown portion (308) surrounding the crown of the tooth (301) and a root portion (e.g., 306) approximating the shape of the root of the tooth (bottom part of 301), and wherein the crown portion (308) of the closed cutting surface (302) comprises a volume greater than the volume of the crown of the tooth (301); and applying the cutting surface (302) to the tooth (301) to separate the gingiva (300) from the tooth of the computer model (301)(step 260). These steps are discussed in the Application, for example, at least at page 12, line 15, through page 17, line 18; page 18, line 25, through page 21, line 3; Figures 5-12 and 14.

Independent claim 21 is directed to a system for separating gingiva (300) from a tooth (301) on a computer model of the gingiva (300) and the tooth (301). The system includes a means for defining a three dimensional closed cutting surface (302) passing through a line (304) between the gingiva (300) and a crown of the tooth of the computer model (301), wherein the closed cutting surface (302) comprises a crown portion (308) surrounding the crown of the tooth

(301) and a root portion approximating the shape of a root of the tooth (301), and wherein the crown portion (308) of the closed cutting surface (302) comprises a volume greater than the volume of the crown of the tooth (301); and means for applying the cutting surface (302) to the tooth (301) to separate the gingiva (300) from the tooth of the computer model (301). Structure for the claimed functions is discussed in the Application, for example, at least at page 18, line 25 through page 20, line 25; Figure 14.

Independent claim 22 is directed to a computer program, residing on a tangible storage medium (406), for use in separating gingiva (300) from a computer model of a tooth (301). The program includes executable instructions operable to cause a computer (400) to: define a three dimensional closed cutting surface (302) passing through a line (304) between the gingiva (300) and a crown of the tooth (301), wherein the closed cutting surface (302) comprises a crown portion (308) surrounding the crown of the tooth (301) and a root portion (306) approximating the shape of a root of the tooth (301), and wherein the crown portion (308) of the closed cutting surface (302) comprises a volume greater than the volume of the crown of the tooth (301); and apply the cutting surface (302) to the tooth (301) to separate the gingiva (300) from the tooth (301) in a single cut. These elements are discussed in the Application, for example, at least at page 12, line 15, through page 17, line 18; page 18, line 25, through page 21, line 3; Figures 5-12 and 14.

Independent claim 23 is directed to a computer program, residing on a tangible storage medium (406), for use in separating gingiva (300) from a computer model of a tooth (301). The program comprising executable instructions operable to cause a computer (400) to: define a three dimensional closed cutting surface (302) passing through a line (304) between the gingiva (300) and a crown of the tooth (301), wherein the closed cutting surface (302) comprises a crown portion (308) surrounding the crown of the tooth (301) and a root portion (306) approximating the shape of a root of the tooth (301), and wherein the cutting surface (302) is expressed as a spline function and a quadratic function, the crown portion (308) of the closed cutting surface (302) comprising a volume greater than the volume of the crown of the tooth (301); and apply the cutting surface (302) to the tooth (301) to separate the gingiva (300) from the tooth (301) in a single cut. These elements are discussed in the Application, for example, at

least at page 12, line 15, through page 17, line 18; page 18, line 25, through page 21, line 3; Figures 5-12 and 14.

Independent claim 24 is directed to a computer (400), comprising: a processor (402); a data storage device (406) coupled to the processor (402), the data storage device (406) containing a computer program for use in separating gingiva (300) from a computer model of a tooth (301). The program comprising executable instructions operable to cause a computer (400) to: define a three dimensional closed cutting surface (302) passing through a line (304) between the gingiva (300) and a crown of the tooth (301), wherein the closed cutting surface (302) comprises a crown portion (308) surrounding the crown of the tooth (301) and a root portion (306) approximating the shape of a root of the tooth (301), and wherein the cutting surface (302) is expressed as a spline function and a quadratic function, and wherein the cutting surface (302) further comprises a plurality of surfaces, and wherein a root of the tooth (301) is modeled as a parabolic surface below a gingival line (304), the crown portion (308) of the closed cutting surface comprising a volume greater than the volume of the crown of the tooth (301); and apply the cutting surface (302) to the tooth to separate the gingiva (300) from the tooth (301). These elements are discussed in the Application, for example, at least at page 12, line 15, through page 17, line 18; page 18, line 25, through page 21, line 3; Figures 5-12 and 14.

Independent claim 26 is directed to a computer-implemented method for separating tooth (301) from gingiva (300). The method includes defining a three dimensional closed cutting surface (302) passing through a line (304) between the gingiva (300) and a crown of the tooth (301), wherein the closed cutting surface (302) comprises a crown portion (308) surrounding the crown of the tooth (301) and a root portion (306) approximating the shape of a root of the tooth of a computer model (301), and wherein the crown portion (308) of the closed cutting surface (302) comprises a volume greater than the volume of the crown of the tooth of the computer model (301); and applying the cutting surface (302) to the tooth (301) to separate the gingiva (300) and reconstruct the root for the tooth (301). These steps are discussed in the Application, for example, at least at page 12, line 15, through page 17, line 18; page 18, line 25, through page 21, line 3; Figures 5-12 and 14.

Independent claim 37 is directed to a computer-implemented method for separating gingiva (300) from a tooth (301) on a computer model of the gingiva (300) and the tooth (301). The method includes defining a three dimensional closed cutting surface (302) passing through a line (304) between the gingiva (300) and a crown of the tooth of the computer model (upper part of 301), wherein the closed cutting surface (302) comprises a crown portion (308) surrounding the crown of the tooth (301), and wherein the crown portion (308) of the closed cutting surface (302) comprises a volume greater than the volume of the crown of the tooth (301); and applying the cutting surface (302) to the tooth (301) to separate the gingiva (300) from the tooth of the computer model (301)(step 260). These steps are discussed in the Application, for example, at least at page 12, line 15, through page 17, line 18; page 18, line 25, through page 21, line 3; Figures 5-12 and 14.

Independent claim 38 is directed to a system for separating gingiva (300) from a tooth (301) on a computer model of the gingiva (300) and the tooth (301). The system includes a processor (402); a data storage device (406) coupled to the processor (402), the data storage device (406) containing a computer program for use in separating gingiva (300) from a computer model of a tooth (301). The program comprising executable instructions operable to cause a computer to: define a three dimensional closed cutting surface (302) passing through a line (304) between the gingiva (300) and a crown of the tooth (301), wherein the closed cutting surface (302) comprises a crown portion (308) surrounding the crown of the tooth (301), and wherein the crown portion (308) of the closed cutting surface (302) comprises a volume greater than the volume of the crown of the tooth (301); and apply the cutting surface (302) to the tooth (301) to separate the gingiva (300) from the tooth (301). These elements are discussed in the Application, for example, at least at page 12, line 15, through page 17, line 18; page 18, line 25, through page 21, line 3; Figures 5-12 and 14.

Independent claim 39 is directed to a computer program, residing on a tangible storage medium (406), for use in separating gingiva (300) from a computer model of a tooth (301). The program comprising executable instructions operable to cause a computer (400) to: define a three dimensional closed cutting surface (302) passing through a line (304) between the gingiva (300) and a crown of the tooth (301), wherein the closed cutting surface (302) comprises

a crown portion (308) surrounding the crown of the tooth (301), and wherein the crown portion (308) of the closed cutting surface (302) comprises a volume greater than the volume of the crown of the tooth (301); and apply the cutting surface (302) to the tooth (301) to separate the gingiva (300) from the tooth (301) in a single cut. These elements are discussed in the Application, for example, at least at page 12, line 15, through page 17, line 18; page 18, line 25, through page 21, line 3; Figures 5-12 and 14.

6. GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

I. Whether claims 1-4, 6-7, 10-17, 21-22, 24-28, 30-31, and 37-39 were properly rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 5,975,893 to Chishti *et al.* (hereinafter "Chishti") in view of U.S. Patent No. 6,606,091 to Liang *et al.* (hereinafter "Liang").

II. Whether claims 4-5, 8-9, 23 and 29 were properly rejected under 35 U.S.C. § 103(a) as being unpatentable over Chishti in view of Liang as applied to claim 1 above, and further in view of U.S. Patent No. 5,431,562 to Andreiko *et al.* (hereinafter "Andreiko").

III. Whether claims 17-20 were properly rejected under 35 U.S.C. § 103(a) as being unpatentable over Chishti in view of Liang as applied to claim 1 above, and further in view of U.S. Patent No. 6,402,707 to Ernst (hereinafter "Ernst").

7. ARGUMENT

As a preliminary matter, Appellants respectfully object to the 12/17/2009 Office action as including insufficient basis for the rejection of previously allowed claims, and submit that the current rejections unnecessarily hinder prompt prosecution of the present application by re-visiting art references that were already considered previously in prosecution.

By way of background, Appellants point out that per the Office Action mailed on April 13, 2009, claims 22-25 and 38-39 were indicated as being allowed. The rejections remaining in the 4/13/09 Office action where successfully addressed in Applicants' subsequent

response filed 8/12/09. In the Office Action of 12/17/09, however, the previously indicated allowability of the claims was withdrawn and the presently contested rejections to the claims applied. As the basis of withdrawing the previously indicated allowability of pending claims, the 12/17/2009 Office Action identifies "newly discovered" references to Chishti (5,975,893) and Liang (6,606,091).

Despite being identified as "newly discovered" references, however, both Chishti and Liang had already been considered by the Office earlier in prosecution. Chishti was cited nearly six years ago in IDS mailed 8/27/2003 and then again in an IDS mailed 9/7/2004. As evidenced by his signature dated 1/11/2005 (see 1/14/2005 Office Action), then assigned Examiner Todd E. Manahan expressly considered Chishti during prosecution[1]. Furthermore, WO09/858596 is a continuation-in-part of Chishti and was cited by the Examiner during prosecution (see, e.g., Office Action mailed 1/14/2005) and addressed by Appellants. In addition, Liang has already been cited by the presently assigned Examiner during prosecution (see, e.g., Office Action mailed 1/22/2009), and Appellants addressed the reference and overcame the corresponding rejection.

Appellants respectfully submit that full faith and credit should be afforded to the search and action of the previous Examiners, per MPEP §706.04, particularly in light of the lengthy pendency and robust prosecution history of the present case. Requiring Appellants to repeatedly address references already formally considered by the Office, with no apparent justification, does little more than unnecessarily delay prosecution. Accordingly, Appellants respectfully submit that the current rejections should be reversed for at least this reason.

I. The rejection of claims 1-4, 6-7, 10-17, 21-22, 24-28, 30-31, and 37-39 under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 5,975,893 to Chishti *et al.* in view of U.S. Patent No. 6,606,091 to Liang *et al.* should be reversed

Claims 1-4, 6-7, 10-17, 21-22, 24-28, 30-31, and 37-39 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 5,975,893 to Chishti in view of U.S.

Patent No. 6,606,091 to Liang. Appellants believe that the above identified pending claims include elements not taught or suggested by the cited references, taken alone or in combination, and respectfully traverse this rejection for at least the reasons discussed below.

The determination of obviousness under 35 U.S.C. § 103 is a legal conclusion based on underlying findings of fact. *In re Kotzab*, 217 F.3d 1365, 1369, 55 USPQ2d 1313, 1316 (Fed. Cir. 2000). The underlying factual determinations include: (1) the scope and content of the prior art; (2) any differences between the claimed subject matter and the prior art; (3) the level of skill in the art; and (4) where in evidence, so-called secondary considerations. *Graham v. John Deere Co.*, 383 U.S. 1, 17-18, 148 USPQ 459, 467 (1966). See also *KSR*, 127 S. Ct. at 1734, 82 USPQ2d at 1391.

The PTO has the initial burden of establishing a *prima facie* case of obviousness. *In re Fine*, 837 F.2d 1071, 1074, 5 USPQ2d 1596, 1598 (Fed. Cir. 1988). The PTO can satisfy this burden by showing some objective teaching in the prior art which would have led one of ordinary skill in the art to the invention claimed. *Fine*, 837 at 1074, 5 USPQ2d at 1598. "If the examiner does not produce a *prima facie* case, the applicant is under no obligation to submit evidence of nonobviousness." MPEP § 2142. "Rejections on obviousness cannot be sustained with mere conclusory statements; instead, there must be some articulated reasoning with some rational underpinning to support the legal conclusion of obviousness." *In re Kahn*, 441 F.3d 977, 988, 78 USPQ2d 1329, 1336 (Fed. Cir. 2006). See also *KSR*, 127 S.Ct. at 1741 (quoting Federal Circuit statement with approval). All limitations of the claimed invention must be taught or suggested by the prior art to establish obviousness. *In re Royka*, 490 F.2d 981, 985, 180 USPQ 580, 583 (CCPA 1974).

Appellants respectfully submit that a *prima facie* case of obviousness has not been established at least because 1) by failing to make the underlying factual determinations per *Graham*, the Office Action fails to articulate a basis for rejection that would substantiate a case of obviousness; and 2) the cited references, taken alone or in combination, fail to teach or suggest the currently claimed invention. These reasons for traversal are discussed in greater detail below.

[1] The current Examiner is the third Examiner assigned to the present case.

Appellants present arguments with specific reference to independent claim 1 in order to correspond response with the rejections as stated in the 12/17/09 Office Action. Pending independent claims 21, 22, 24, 26, and 37-39 being traversed for at least a similar rationale. Independent claim 1 reads as follows:

> A computer-implemented method for separating gingiva from a tooth on a computer model of the gingiva and the tooth, the method comprising:
>
> defining a three dimensional closed cutting surface passing through a line between the gingiva and a crown of the tooth of the computer model, the crown defining a volume, wherein the closed cutting surface comprises a crown portion surrounding the crown of the tooth and a root portion approximating the shape of the root of the tooth, and wherein the crown portion of the closed cutting surface comprises a volume greater than the volume of the crown of the tooth; and
>
> applying the cutting surface to the tooth to separate the gingiva from the tooth of the computer model.

First, Appellants submit that the 12/17/09 Office Action fails to articulate a rejection that would substantiate a case of obviousness. In particular, the Office Action is deficient in addressing the scope and content of the cited references, and the differences between the cited references and the invention as claimed, as required per an obviousness inquiry under *Graham*, and more recently in *KSR*.

Rather than making a factual determination based on the *Graham* factors, the Office action virtually ignores the specific language recited in the pending claims in characterizing the teachings of the cited references. For example, it is stated at page 2 of the 12/17/09 Office Action that "Chishti discloses a method including providing three dimensional image of a patient's jaw including teeth, gingival, and oral tissues (col. 10, lines 66 to col. 12 lines 3) and removing unwanted or unnecessary section of the jaws using eraser tool." With respect to Liang, the Office Action indicates that "Liang teaches 3D model for masking out undesirable parts of a data set (abstract, last 3 lines)." *Id.*

It is unclear, however, how the eraser tool of Chishti or the masking out of Liang is believed to specifically teach, e.g., "...defining a three dimensional closed cutting surface

passing through a line between the gingiva and a crown of the tooth of the computer model, the crown defining a volume, wherein the closed cutting surface comprises a crown portion surrounding the crown of the tooth and a root portion approximating the shape of the root of the tooth, and wherein the crown portion of the closed cutting surface comprises a volume greater than the volume of the crown of the tooth...", as specifically recited in claim 1. The Office Action fails to establish that these aspects of claim 1 would be found in the cited references. In fact, the Office action fails to directly address the recited aspects of claim 1, leaving Appellants in an uncertain position in providing meaningful response to the Office Action.

It is further alleged in the 12/17/09 Office action (p.3) that "...it would have obvious to one of ordinary skill in the art to find a line to separate unwanted structure, such as gum from a desired structure." It is unclear whether the Examiner believes this aspect of the claimed invention is found in the cited references or elsewhere.

Per MPEP §2142, "...the examiner bears the initial burden of factually supporting any *prima facie* conclusion of obviousness. If the examiner does not produce a *prima facie* case, the applicant is under no obligation to submit evidence of nonobviousness." MPEP §2142. In the present instance, the Office action fails to specifically address the language of the pending claims, and certainly fails to identify where each and every element of claim 1, e.g., is believed to be found in the cited references. As such, the rejection should be reversed for at least this reason.

Second, regardless of the deficiencies in the stated case for obviousness in the 12/17/09 Office Action, Appellants respectfully submit that the cited references, taken alone or in combination, simply fail to teach or reasonably suggest the currently claimed invention, e.g., as recited in claim 1.

In particular, Chishti and Liang, at a minimum fail to teach defining a three dimensional closed cutting surface passing through a line between the gingiva and a crown of the tooth of the computer model, the crown defining a volume, wherein the closed cutting surface comprises a crown portion surrounding the crown of the tooth and a root portion approximating the shape of the root of the tooth, and wherein the crown portion of the closed cutting surface comprises a volume greater than the volume of the crown of the tooth, as recited in claim 1.

These elements, which are missing from Chishti and Liang, are recited in independent claim 1 and certain aspects (e.g., the crown portion) are similarly captured in independent claims 21, 22, 24, 26, and 37-39, and incorporated in dependent claims 2-4, 6-7, 10-17, 25, 27-28, and 30-31.

Moreover, these elements are supported throughout the specification as originally filed (see, e.g., Figures 6, 8B, 11, and 12). Attention is respectfully drawn, for example, to the exemplary embodiment illustrated in Figure 6 and the corresponding discussion in the detailed description at page 13, paragraph [0065], which illustrates a cutter shaped like a sort of "ice-cream cone", with the top surrounding the crown of the tooth to be extracted, and the bottom embedded in side the gingival to define the tooth root portion of the closed cutting surface. As illustrated in Figure 11, the 3D closed cutter provides a cutting surface well suited for the gingiva/crown tissue morphology, and ensures (e.g., via cutter volume aspects) maximized capture of the tooth crown. These elements, as specifically recited in the pending claims, are not taught or reasonably suggested by Chishti or Liang, taken alone or in combination.

Chishti, which is commonly assigned compared to the current application, discloses a method and system for incrementally moving teeth from an initial tooth arrangement to a final tooth arrangement. In manipulating a digital dental model, Chishti discloses the use of, for example, an eraser tool that can be used to remove unwanted sections from a three-dimensional image of a patient's jaw (see, e.g., col. 10, ll. 66 to col. 12, ll. 3 of Chishti, as cited at p.2 of the 12/17/09 Office Action). In some embodiments, a saw tool can be used to define the individual teeth/groups of teeth to be moved by, for example, defining a path between two curves lying in space (e.g., a 2-D cutting path) for cutting the graphic image (see, e.g. col. 11, line 46 of Chishti, as cited at p. 3 of the 12/17/09 Office Action).

While the cited teachings of Chishti might be considered similar to the currently claimed method of claim 1 in the general sense that both the cited provisions of Chishti and claim 1 of the present invention relate to manipulation of digital dentition components, Chishti fails to teach the specific techniques described in the present specification and currently recited in claim 1. In particular, while providing a considerable advancement to the art, Chishti does not teach defining a three dimensional closed cutting surface passing through a line between the gingiva and a crown of the tooth of the computer model, the crown defining a volume, wherein

the closed cutting surface comprises a crown portion surrounding the crown of the tooth and a root portion approximating the shape of the root of the tooth, and wherein the crown portion of the closed cutting surface comprises a volume greater than the volume of the crown of the tooth; and applying the cutting surface to the tooth to separate the gingiva from the tooth of the computer model, as recited in claim 1.

Liang discloses a system for 3D object extraction from 2D slice-based medical images. The 12/17/09 Office Action (p.2) cites to the abstract of Liang mentioning masking out of the undesirable parts of a data set. Again, it is insufficient for establishing *prima facie* obviousness to merely point out that the Liang reference discloses some method removing or masking out parts of a data set, while failing to explore or address differences between the currently claimed method and the techniques of Liang.

In this instance, the cited reference fails to teach the specific techniques described in the present specification and currently recited in claim 1. Even on a broad conceptual level, the difference between "masking out" of data as in Liang and the precise, cutter-defined, component separating techniques recited in claim 1 would be apparent to one of ordinary skill. Additionally, there is no evidence that the complex 3D image reconstruction process of Liang could even practically be applied to separation of dentition components, in the manner described in the specification and recited in the currently pending claims.

Regarding the specific techniques of Liang, the disclosure is primarily directed to a 3D image reconstruction from a stack of 2D scan slices. While specific details regarding masking out are limited, Liang discloses potential use of a reconstructed image of an object as a mask to constrain the data set (see, e.g., Liang, Abstract; FIG. 13A; col. 9, ll. 50-56). It is unclear from the 12/17/09 Office action exactly how the masking out of Liang is applied in the Office Action to correspond to particular elements recited in claim 1. Presuming the masking out of Liang is being cited by the Examiner as corresponding to the 3D closed cutting surface recited in claim 1, this aspect of claim 1 is readily distinguished from Liang for numerous reasons. For example, as the reconstructed object itself is the mask in Liang, at a minimum, Liang would fail to teach a mask having the relative volume characteristics as the closed cutting surface recited in claim 1. In particular, Liang would fail to teach a 3D closed cutting surface

where "...the crown portion of the closed cutting surface comprises a volume greater than the volume of the crown of the tooth...", as specifically recited in claim 1.

Thus, the mere fact that Liang discloses masking out one portion of data from another portion of data falls far short of providing the specific method, as disclosed in the present specification and defined by the current claims, of separating gingival from a tooth on a computer model of the gingival and the tooth, including each and every element as specifically recited in claim 1. As such, Liang fails to provide the teachings that are missing from Chishti.

For at least the reasons set forth above, the cited references of Chishti and Liang, taken alone or in combination, do not teach or reasonably suggest the currently claimed invention, *e.g.*, as recited in claim 1. As such, a *prima facie* case of obviousness cannot be found. Accordingly, the rejection of claims 1-4, 6-7, 10-17, 21-22, 24-28, 30-31, and 37-39 under 35 U.S.C. § 103(a) should be reversed and the claims allowed.

II. The rejection of claims 4-5, 8-9, 23 and 29 under 35 U.S.C. § 103(a) as being unpatentable over Chishti in view of Liang as applied to claim 1 above, and further in view of U.S. Patent No. 5,431,562 to Andreiko should be reversed

Claims 4-5, 8-9, 23 and 29 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Chishti in view of Liang as applied to claim 1 above, and further in view of U.S. Patent No. 5,431,562 to Andreiko. Appellants believe that a case of *prima facie* obviousness cannot be found for at least the reasons set forth below.

The 12/17/09 Office Action cites to the rejection of claim 1 in view of Chishti and Liang for application of Chishti/Liang to the presently rejected claims. The combination of Chishti and Liang as applied to dependent claims 4-5, 8-9, 23 and 29 is traversed for at least the reasons set forth above for independent claim 1. In particular, the cited references of Chishti and Liang fail to teach or suggest the invention as recited in claim 1 as indicated above.

With regard to Andreiko, the Office Action states simply that "Andreiko teaches a spline and parabolic function for a curve." No further characterization of the Andreiko disclosure is provided and no citation is provided in the Office Action to the provisions of

Andreiko believed to be relevant to the current rejection. The rejections should be reversed for at least for lacking sufficient detail to meet the Office's burden of establishing prima facie obviousness per the factors set forth in *Graham*.

At a minimum, Andreiko fails to provide the teachings that are missing from Chishti and Liang. In particular, Andreiko, taken alone or in combination with Chishti/Liang, fails to teach or suggest defining a three dimensional closed cutting surface passing through a line between the gingiva and a crown of the tooth of the computer model, the crown defining a volume, wherein the closed cutting surface comprises a crown portion surrounding the crown of the tooth and a root portion approximating the shape of the root of the tooth, and wherein the crown portion of the closed cutting surface comprises a volume greater than the volume of the crown of the tooth, as recited in claim 1. As such, the cited references, alone or in combination, fail to teach the invention as recited in claim 1. Claim 23 is traversed for a similar rationale, though it is noted that the Office action links the rejection of claim 23 to the reasoning for rejecting claim 1. Dependent claims 4-5, 8-9, and 29 will be allowable at least for depending from allowable independent claim 1.

Accordingly, the rejection of claims 4-5, 8-9, 23 and 29 under 35 U.S.C. § 103(a) should be reversed and the claims allowed.

III. The rejection of claims 17-20 under 35 U.S.C. § 103(a) as being unpatentable over Chishti in view of Liang as applied to claim 1 above, and further in view of U.S. Patent No. 6,402,707 to Ernst should be reversed

Claims 17-20 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Chishti in view of Liang as applied to claim 1 above, and further in view of U.S. Patent No. 6,402,707 to Ernst. Appellants believe that a case of *prima facie* obviousness cannot be found for at least the reasons set forth below.

The 12/17/09 Office Action cites to the rejection of claim 1 in view of Chishti and Liang for application of Chishti/Liang to the presently rejected claims. The combination of

Chishti and Liang as applied to dependent claims 17-20 is traversed for at least the reasons set forth above for independent claim 1. In particular, the cited references of Chishti and Liang fail to teach or suggest the invention as recited in claim 1 as indicated above. Ernst fails to provide the teaching that are missing from Chishti and Liang.

Ernst discloses real time intra-oral acquiring and registering of 3D measurements and images of intra-oral objects and features. The 12/17/09 Office Action cites to col. 12, ll. 41-45 of Ernst as teaching a cylindrical coordinate system. The cited provision of Ernst, however, is directed to registering and acquiring intra-oral measurements and images. No teachings of a cutter for separating dentition components is found, and it is unclear what, if anything, Ernst adds to the record other than mentioning the term cylindrical coordinate system in the context of an oral cavity of a dental patient.

At a minimum, Ernst fails to provide the teachings that are missing from Chishti and Liang. In particular, Ernst, taken alone or in combination with Chishti/Liang, fails to teach or suggest defining a three dimensional closed cutting surface passing through a line between the gingiva and a crown of the tooth of the computer model, the crown defining a volume, wherein the closed cutting surface comprises a crown portion surrounding the crown of the tooth and a root portion approximating the shape of the root of the tooth, and wherein the crown portion of the closed cutting surface comprises a volume greater than the volume of the crown of the tooth, as recited in claim 1. As such, the cited references, alone or in combination, fail to teach the invention as recited in claim 1. Dependent claims 17-20 will be allowable at least for depending from allowable independent claim 1.

Accordingly, the rejection of claim 17-20 under 35 U.S.C. § 103(a) should be reversed and the claims allowed.

8. CONCLUSION

For these reasons, it is respectfully submitted that the rejections should be reversed.

Respectfully submitted,

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9. CLAIMS APPENDIX

1. (Previously presented) A computer-implemented method for separating gingiva from a tooth on a computer model of the gingiva and the tooth, the method comprising:

defining a three dimensional closed cutting surface passing through a line between the gingiva and a crown of the tooth of the computer model, the crown defining a volume, wherein the closed cutting surface comprises a crown portion surrounding the crown of the tooth and a root portion approximating the shape of the root of the tooth, and wherein the crown portion of the closed cutting surface comprises a volume greater than the volume of the crown of the tooth; and

applying the cutting surface to the tooth to separate the gingiva from the tooth of the computer model.

2. (Original) The method of claim 1, wherein the cutting surface is curved.

3. (Original) The method of claim 1, wherein the cutting surface is expressed as a function.

4. (Original) The method of claim 1, wherein the cutting surface is expressed as a spline function and a quadratic function.

5. (Original) The method of claim 1, wherein the cutting surface is expressed as a spline function and a parabolic function.

6. (Original) The method of claim 1, wherein the cutting surface is interactively adjusted.

7. (Original) The method of claim 4, wherein the interactive adjustment of the cutting surface modifies a function defining the cutting surface.

8. (Previously presented) The method of claim 4, further comprising interactively highlighting the separated gingiva.

9. (Previously presented) The method of claim 8, further comprising interactively highlighting a border of the separated gingiva.

10. (Original) The method of claim 1, wherein the cutting surface is defined by specifying a basis for the tooth.

11. (Original) The method of claim 1, further comprising finding a gingival line separating a tooth surface and a gingiva.

12. (Original) The method of claim 11, further comprising finding the high curvature location on the tooth surface.

13. (Original) The method of claim 11, further comprising fitting a spline to the gingival line.

14. (Original) The method of claim 1, wherein the cutting surface further comprises a plurality of surfaces.

15. (Original) The method of claim 14, wherein the root of the tooth is modeled as a parabolic surface below a gingival line.

16. (Original) The method of claim 14, further comprising defining an enclosing surface to enclose the crown of the tooth.

17. (Previously presented) The method of claim 14, further comprising:
displaying the cutting surface specified with a plurality of nodes;
adjusting one or more nodes to modify the surface; and
applying the surface to separate the gingiva from the tooth.

18. (Previously presented) The method of claim 17, further comprising providing a handle to adjust an orientation of the cutting shape.

19. (Original) The method of claim 17, wherein adjusting one or more nodes further comprises moving one or more nodes.

20. (Original) The method of claim 17, wherein the cutting surface is formed using a function in a cylindrical coordinate system.

21. (Previously presented) A system for separating gingiva from a tooth on a computer model of the gingiva and the tooth, the system comprising:

means for defining a three dimensional closed cutting surface passing through a line between the gingiva and a crown of the tooth of the computer model, wherein the closed cutting surface comprises a crown portion surrounding the crown of the tooth and a root portion approximating the shape of a root of the tooth, and wherein the crown portion of the closed cutting surface comprises a volume greater than the volume of the crown of the tooth; and

means for applying the cutting surface to the tooth to separate the gingiva from the tooth of the computer model.

22. (Previously presented) A computer program, residing on a tangible storage medium, for use in separating gingiva from a computer model of a tooth, the program comprising executable instructions operable to cause a computer to:

define a three dimensional closed cutting surface passing through a line between the gingiva and a crown of the tooth, wherein the closed cutting surface comprises a crown portion surrounding the crown of the tooth and a root portion approximating the shape of a root of the tooth, and wherein the crown portion of the closed cutting surface comprises a volume greater than the volume of the crown of the tooth; and

apply the cutting surface to the tooth to separate the gingiva from the tooth in a single cut.

23. (Previously presented) A computer program, residing on a tangible storage medium, for use in separating gingiva from a computer model of a tooth, the program comprising executable instructions operable to cause a computer to:

define a three dimensional closed cutting surface passing through a line between the gingiva and a crown of the tooth, wherein the closed cutting surface comprises a crown portion surrounding the crown of the tooth and a root portion approximating the shape of a root of the tooth, and wherein the cutting surface is expressed as a spline function and a quadratic function, the crown portion of the closed cutting surface comprising a volume greater than the volume of the crown of the tooth; and

apply the cutting surface to the tooth to separate the gingiva from the tooth in a single cut.

24. (Previously presented) A computer, comprising:

a processor;

a data storage device coupled to the processor, the data storage device containing a computer program for use in separating gingiva from a computer model of a tooth, the program comprising executable instructions operable to cause a computer to:

define a three dimensional closed cutting surface passing through a line between the gingiva and a crown of the tooth, wherein the closed cutting surface comprises a crown portion surrounding the crown of the tooth and a root portion approximating the shape of a root of the tooth, and wherein the cutting surface is expressed as a spline function and a quadratic function, and wherein the cutting surface further comprises a plurality of surfaces, and wherein a root of the tooth is modeled as a parabolic surface below a gingival line, the crown portion of the closed cutting surface comprising a volume greater than the volume of the crown of the tooth; and

apply the cutting surface to the tooth to separate the gingiva from the tooth.

25. (Original) The system of claim 24, further comprising instructions to define an enclosing surface to enclose the crown of the tooth.

26. (Previously presented) A computer-implemented method for separating tooth from gingiva, comprising:

defining a three dimensional closed cutting surface passing through a line between the gingiva and a crown of the tooth of a computer model, wherein the closed cutting surface comprises a crown portion surrounding the crown of the tooth and a root portion approximating the shape of a root of the tooth, and wherein the crown portion of the closed cutting surface comprises a volume greater than the volume of the crown of the tooth; and

applying the cutting surface to the tooth to separate the gingiva of the computer model and reconstruct the root for the tooth.

27. (Previously presented) The method of claim 1, further comprising:

visually displaying the cutting surface to a user as two surfaces representing opposed sides of the separation between the gingiva and the tooth; and

allowing the user to determine whether to separate the gingiva from the tooth.

28. (Previously presented) The method of claim 1, wherein the crown surface is modeled as a one or more functions.

29. (Previously presented) The method of claim 28, wherein the crown surface is modeled as a quadratic function in polar coordinates.

30. (Previously presented) The method of claim 1, further comprising allowing a user to change a shape of the crown surface.

31. (Previously presented) The method of claim 30, wherein allowing the user to change the shape comprises allowing the user to move at least one of crown control points, top control points and a gingival line.

32-36. (Canceled).

37. (Previously presented) A computer-implemented method for separating gingiva from a tooth on a computer model of the gingiva and the tooth, the method comprising:

defining a three dimensional closed cutting surface passing through a line between the gingiva and a crown of the tooth of the computer model, wherein the closed cutting

surface comprises a crown portion surrounding the crown of the tooth, and wherein the crown portion of the closed cutting surface comprises a volume greater than the volume of the crown of the tooth; and

applying the cutting surface to the tooth to separate the gingiva from the tooth of the computer model.

38. (Previously presented) A system for separating gingiva from a tooth on a computer model of the gingiva and the tooth, the system comprising:

a processor;

a data storage device coupled to the processor, the data storage device containing a computer program for use in separating gingiva from a computer model of a tooth, the program comprising executable instructions operable to cause a computer to:

define a three dimensional closed cutting surface passing through a line between the gingiva and a crown of the tooth, wherein the closed cutting surface comprises a crown portion surrounding the crown of the tooth, and wherein the crown portion of the closed cutting surface comprises a volume greater than the volume of the crown of the tooth; and

apply the cutting surface to the tooth to separate the gingiva from the tooth.

39. (Previously presented) A computer program, residing on a tangible storage medium, for use in separating gingiva from a computer model of a tooth, the program comprising executable instructions operable to cause a computer to:

define a three dimensional closed cutting surface passing through a line between the gingiva and a crown of the tooth, wherein the closed cutting surface comprises a crown portion surrounding the crown of the tooth, and wherein the crown portion of the closed cutting surface comprises a volume greater than the volume of the crown of the tooth; and

apply the cutting surface to the tooth to separate the gingiva from the tooth in a single cut.

10. EVIDENCE APPENDIX

None.

11. RELATED PROCEEDINGS APPENDIX

None.